# BOOKS & ARTS

# Amphibian mystery misread

A book blaming a fungus for the disappearance of amphibians from wild places wrongly downplays the role of environmental change, warn **Alan Pounds** and **Karen Masters**.

**Extinction in Our Times: Global Amphibian Decline**
by James P. Collins and Martha L. Crump
Oxford University Press: 2009. 304 pp. $29.95

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Amphibians such as this Tapichalaca tree frog are seen as bellwethers of environmental deterioration.

Across the globe, frogs, toads and salamanders are disappearing, even in protected habitats. In *Extinction in Our Times*, James Collins and Martha Crump try to reassure us that these vanishing creatures are not warning of large-scale environmental deterioration like canaries in a coal mine, but are simply "telling us that they themselves are in trouble".

The cause of amphibian declines in wild places, the authors assert, is often a single agent: the chytrid fungus *Batrachochytrium dendrobatidis*, which can produce a fatal skin disease in these animals. According to this view, the mass die-offs result from movement of the fungus between continents and across landscapes. However, this 'lone killer' hypothesis wrongly downplays the role of environmental change.

Collins and Crump see evidence for a lone-killer chytrid in reports that a wave of amphibian extinction spread with the fungus from northwest to southeast across Central America, beginning in the early 1980s. But this wave is still being evaluated. Federico Bolaños at the University of Costa Rica in San Pedro and his co-workers propose that it stems from biased sampling and from a failure to take into account all of the region's amphibian die-offs. Moreover, this pattern does not rule out the importance of environmental change in these declines. Studies of such losses must test hypotheses that consider multiple factors.

The authors recognize the interplay of factors, but treat this as a complication that obscures a simple reality. If the chytrid plays a part in a die-off, they reason, then other forces are not needed. This is like attributing a car crash to excessive speed and deciding that other contributing issues, such as alcohol consumption, need not be considered. Such a deterministic view of causation, blind to probabilistic influences, has no place in ecology. Nor is the simplest explanation necessarily the best. Collins and Crump invoke Occam's 'law of parsimony', but were Occam here today, he might quiz them about their assumptions.

> "Amphibians are telling us one thing: Earth's life-support system is in trouble."

For one, is the chytrid fungus really deadly? The resulting disease is sometimes lethal but often it is not, for reasons that go beyond genetics and history — environment matters in disease outcomes. Laboratory studies can be misleading: often they put amphibians under stress or erase the microclimatic heterogeneity that helps the animals to fend off disease. Such experiments can also exclude microbes that might otherwise keep the chytrid in check. Add to the picture how little we know about this fungus in the wild, especially outside its amphibian hosts, and the assumption that it is inherently lethal to many species becomes indefensible.

The chytrid's impact may instead depend on environmental changes. Collins and Crump's selection of published work and quoted opinions downplays such links. Nevertheless, studies show that increasingly extreme climate and weather, together with land-use change, pollution, ultraviolet (UV) radiation and species invasions, are degrading amphibian health in many regions. These factors can interact and their effects may cross the boundaries of protected areas. Associations between climatic changes and reduced amphibian survival have been found in western and eastern North America, Central and South America, Australia, Spain, Italy and England.

Evidence showing that amphibians have undergone climatic stress before chytrid outbreaks have taken place challenges the idea of a lone-killer fungus, yet Collins and Crump fail to acknowledge this. Instead, they argue that such evidence casts doubt on the largely untested 'chytrid-thermal-optimum' hypothesis, which proposes that microhabitat temperatures in many places are shifting towards the chytrid's optimum, thereby favouring this pathogen's growth and hindering amphibian defences. However, the climatic-stress hypothesis is compatible with this model. And contrary to the authors' claims, neither hypothesis assumes that the fungus is native to regions that are experiencing die-offs. Climate may influence a disease regardless of the pathogen's place of origin, and the presence of exotic microbes makes global warming an even greater threat.

The authors' narrow thinking biases their 'road map' for future research on amphibian declines. Consider UV radiation, which harms amphibians and interacts with pathogens, chemical pollution and climate in ways that scientists are only beginning to study. For example, global warming alters patterns of cloud cover, reducing UV exposure in some places and increasing it in others. By oversimplifying the

issue, the authors suggest that UV radiation can be removed from the list of potential causes of amphibian die-offs.

Collins and Crump offer little comparison between amphibian declines and losses affecting other species. Organisms from lodgepole pines to African lions are dying en masse because of disease shifts that are linked to global warming and other environmental problems. For instance, in the wake of the European heatwave of 2003, many millions of invertebrate sea creatures, including sponges, molluscs and corals, died along several thousand kilometres of the northwest Mediterranean coastline. After studying a soft coral known as the red gorgonian, marine biologists Marc Bally and Joaquim Garrabou of the University of the Mediterranean in Marseille, France, reported that the high temperatures favoured certain bacteria that ravaged the coral. In Italy, a team led by Ines Di Rosa at the University of Perugia and Daniele Canestrelli at the University of Tuscia in Viterbo proposes that the heatwave had similar consequences for some of Italy's amphibians.

By asking how long it will be before amphibians are safe from the chytrid fungus, *Extinction in Our Times* misses the bigger picture. The interacting changes threaten many life forms. Di Rosa, Canestrelli and their colleagues are studying how climate change and pathogen movement may conspire to cause amphibian die-offs. In Costa Rica, where such losses have accompanied climate-related changes in populations of birds, reptiles, mammals, insects and plants, we are studying orchids that have recently begun to die in the cloud forest. Amphibians belong to a chorus of canaries telling us one thing: Earth's life-support system is in trouble. ■

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# Newton and the money men

**Newton and the Counterfeiter: The Unknown Detective Career of the World's Greatest Scientist**
by Thomas Levenson
Houghton Mifflin Harcourt/Faber and Faber: 2009. 336 pp. $25/£20

After the Glorious Revolution of 1688, in which King James II of England was overthrown by a union of Parliamentarians led by William of Orange, the English government found itself in dire financial straits. It had joined the War of the Grand Alliance against France in 1689, and was struggling to fund its army in a conflict that was to last for another 8 years. To make matters worse, the country was suffering from a lack of good coinage.

As Thomas Levenson explains in his engaging book *Newton and the Counterfeiter*, the government turned to an unlikely hero to save the nation from financial calamity — Isaac Newton.

In the 1660s, the English government had carried out a programme to machine-mill the edges of coins to dissuade unscrupulous operators from 'clipping' the edges and melting down the clippings for personal gain. But by the 1690s, many milled coins had dropped out of circulation, partly because their face value was less than the value of the silver they were made from. This caused a crisis for the Treasury, which would not take clipped coins as payment for tax because they contained less silver. So in 1696, the Treasury resolved to take £7-million-worth of non-milled coins out of circulation (today's circulation is £3.5 billion or US$5.7 billion), melt them down and re-coin them with milled edges.

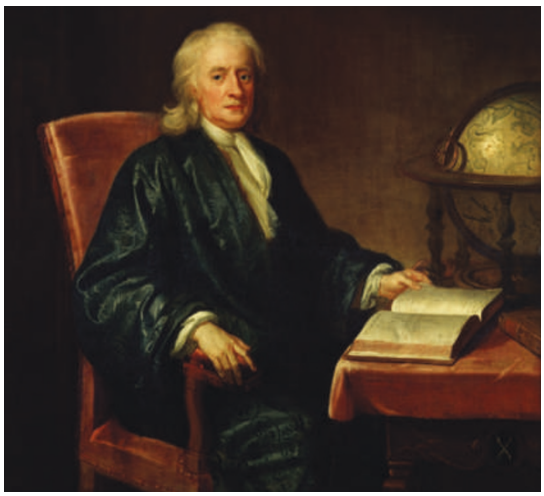
Newton was brought in to manage this operation. An unlikely appointee for the role, he was at that time enjoying fame as the author of *Principia Mathematica*, his seminal work on the foundations of physics, and had just embarked on a radical change of career as a politician. Newton became the Member of Parliament for the University of Cambridge in the Convention Parliament of 1689, formed in the wake of James II's departure. But his efforts to acquire a senior public position in London came to nothing until early 1696. Then, with the backing of his patron Charles Montagu — Chancellor of the Exchequer and 1st Earl of Halifax — Newton was awarded the position of Warden of the Royal Mint.

Although the job had been treated as a sinecure by most of his predecessors, Newton took it on with vigour. He masterfully oversaw the great re-coinage and, after overcoming his initial revulsion, prosecuted with relish the clippers and 'coiners', or counterfeiters, who were partly responsible for the disarray of the country's currency. It wasn't long before his role brought him up against the arch-counterfeiter and forger, William Chaloner, whose skill and success in faking French pistoles (gold coins) and English guineas had quickly taken him from poverty to riches.

The book documents the entertaining relationship between these two geniuses and the different worlds they inhabited. Although their story is well known to historians of science, Levenson's account adds substantially to our knowledge of the social and political background against which it played out. The author manages to unpick many of the tangled and morally ambiguous webs that made up the metropolitan counterfeiting culture of that era, and shows — impressively, given the scant sources available — how Chaloner pulled off many of his brazen schemes.

It is an enthralling tale. At one point, Chaloner became wealthy enough to live in a large house in central London, but just as quickly lost whatever fortune he had made. He bounced back in his typical extraordinary fashion. In February 1697, he managed to convince a Parliamentary committee that was investigating alleged abuses at the Royal Mint — the allegations had come from Chaloner himself — that he could oversee a much more efficient way of producing coinage than the method that was in use.

Newton showed that Chaloner's scheme was unworkable. However, within a year the trickster had distributed a document making further accusations of corruption against members of the Mint, this time alluding to the activities of the warden himself. Again his claims were taken seriously, and Newton and others were



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**As Warden of the Royal Mint, Isaac Newton used his genius to investigate and convict a similarly intellectual counterfeiter.**

# In Retrospect: The earliest picture of evolution?

## Ideas about the mutability of species may have been part of Enlightenment imagery before Lamarck.

**De anima brutorum commentaria (Commentary on the Soul of Animals)**
by Francesco Maria Soldini
Gaetano Cambiagi: 1776

Illustrations can convey scientific ideas as effectively as the written word. It is widely accepted that there was no graphical representation of the evolution of species before 1800, when the naturalist Jean-Baptiste Lamarck added the axis of time to his classification tree diagrams. However, I have found illustrations in a little-known book written by the Carmelite monk Francesco Maria Soldini that predate Lamarck's imagery. Plates in the book, published in Florence in 1776, clearly depict life emerging from the sea onto land.

Written in Latin, *De anima brutorum commentaria* is one of many books printed in the sixteenth and eighteenth centuries on the concept that animals have a soul. Soldini anchors his arguments to the writings of great philosophers from ancient times, such as Aristotle, and to scripture, especially the Book of Genesis. He was also influenced by contemporaries, notably Immanuel Kant, Gottfried Leibniz, Étienne Bonnot de Condillac and Pierre-Louis Moreau de Maupertuis. The book is a very rare volume and its scientific significance has escaped notice until now.

Soldini's book is embellished with eight stunning engravings by an unknown artist that depict natural scenes and animals, bound at the beginning of each chapter. The plates are printed in blue or red to contrast with the elegantly decorated initial letter of the text. But the iconographical content of the images is independent from the writing: many of the animal pictures are taken from the wood carvings of other treatises on zoology, such as those by the sixteenth-century naturalists Ulisse Aldrovandi and Conrad Gesner, which are not cited by Soldini. It is therefore likely that the plates were added separately to decorate the book, which was produced by Gaetano Cambiagi, typographer to the Grand Duke of Tuscany.

In two of the eight plates, the engraver portrays marine animals, mainly crustaceans, leaving the water and colonizing land. These images are reminiscent of the 'Neptunian' theory of Earth described by the French literary scholar and diplomat Benoît de Maillet (1656–1738). In his book *Telliamed*, which circulated for decades before being posthumously published in 1748, de Maillet explains how Earth was once entirely covered by water. He proposes that life began in the water in the form of minuscule seeds that joined together to create all aquatic forms, from which all terrestrial and winged creatures were then derived. In his opinion, all plants and animals would have analogous examples among the aquatic specimens. The plates do indeed display marine animals that have parallels with species living on land, even in their names, such as the mantis shrimp and the fantastical marine rhinoceros. Yet Soldini makes no mention of either *Telliamed* or de Maillet in his otherwise highly referenced book.

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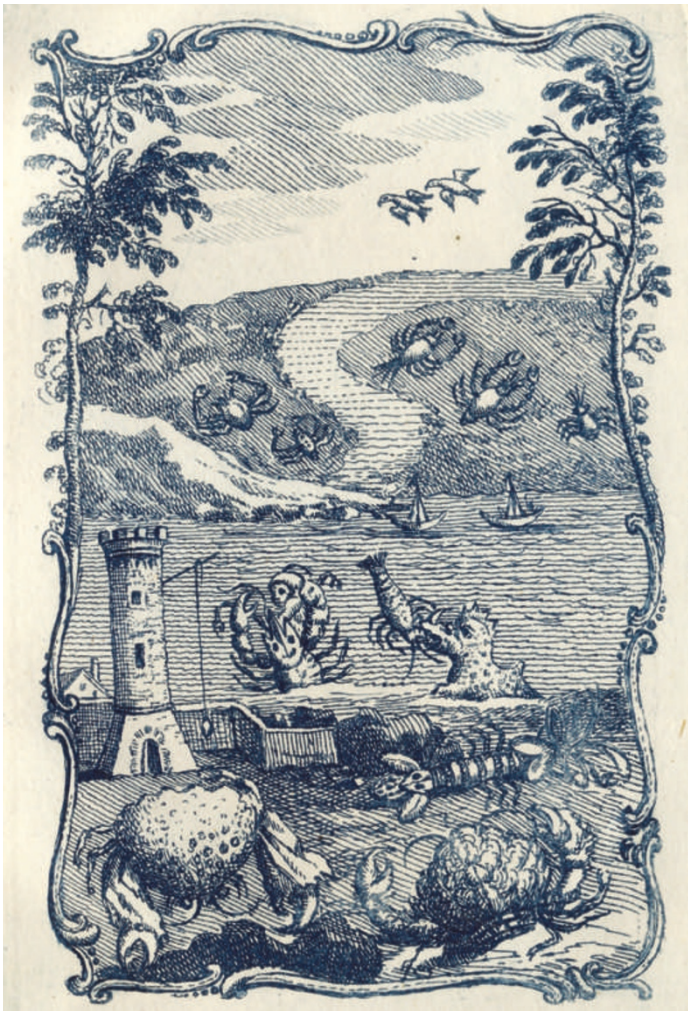
A third plate represents images of fish taken from the iconography of the sixteenth century. They swim holding their heads above water with birds flying above. Such representations follow another de Maillet idea, that animals are derived from two basic types: the flying ones that live between the sea floor and the surface, which today is known as the pelagic zone, and the creatures that crawl on the sea floor, or benthic zone. Birds would have stemmed from the flying type, terrestrial animals from crawling forms.

The anonymous plates in *De anima brutorum commentaria* demonstrate the extent to which evolutionary ideas circulated during the Enlightenment, when drawing and carving were valuable means of transmitting progressive ideas to readers with minds open to novel concepts. ■



**An engraving published in 1776, 83 years before *On the Origin of Species*.**

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**See www.nature.com/darwin/index.html for more on Darwin.**

**Corrections**
In the Book Review 'Amphibian mystery misread' by Alan Pounds and Karen Masters (*Nature* **462,** 38–39; 2009) the sentence "Collins and Crump's selection of published work and quoted opinions downplays such links" should have read "Collins and Crump's assessment of published work and the opinions that they quote downplay such links."

In Alison Abbott's Arts Review 'Florence's observatory restored' (*Nature* **462,** 40; 2009), "Pietro Leopardo" should have read "Pietro Leopoldo".